REVIEW

Psychoneuroimmunology and Chiropractic

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ABSTRACT

Psychoneuroimmunology is the interdisciplinary field that explores the connections between the mind and emotions, the brain and central nervous system, and the immune system. Chiropractic is a non-surgical, drugless form of health care that seeks to optimize health and wellness via the relationship between structure, primarily the spine, and function, primarily the nervous system of the human body. In practice, most chiropractors also emphasize the role of diet, exercise, and lifestyle modification as an adjunct to the healing process. As such, chiropractic is well positioned to make a unique contribution to the field of psychoneuroimmunology.

Key Words: *chiropractic, psychoneuroimmunology, mind-body, health, stress*

Introduction

Krebiozen was a promising new cancer drug in the 1950's. Mr. Wright was a terminal cancer patient dying from advanced lymphosarcoma. His tumors in the neck, axilla, chest, abdomen, and groin were the size of oranges. He was bedridden and his doctor, Dr. Phillip West, drained two liters of lymphatic fluid from his chest due to a blockage of the thoracic duct. Dr. West was one of the doctors chosen to evaluate Krebiozen, and when Mr. Wright learned of this new experimental drug, he begged to be included in the study. However, Mr. Wright was expected to live just a few days and Dr. West had only enough medication for twelve patients. Even though it seemed pointless, Dr. West relented and gave Mr. Wright the drug.

Dr. West administered the first injection on Friday. Considering the grim prognosis, Dr. West did not expect his patient to survive the weekend. He even made plans to transfer the unused Krebiozen drug to a different patient. When he returned to the hospital on Monday, Dr. West was amazed to find Mr. Wright out of bed and well on his way toward a miraculous recovery. His large tumors had *"melted like snowballs on a hot stove."* Mr. Wright was discharged from the hospital ten days later with his cancer in full retreat.

Unfortunately Krebiozen proved to be an ineffective drug. Mr. Wright was the only patient in the large multi-clinic study to show any improvement. When he heard of these negative results, Mr. Wright became disillusioned and his condition worsened. Within two months he was back on death's door. In an attempt to help his patient, Dr. West devised an experiment. He told Mr. Wright that contrary to what he had heard, Krebiozen was indeed a promising drug, it was just that the drug lost strength when it was not fresh. He told Mr. Wright that he was scheduled to receive *"a new super-refined, double-strength"* product the next day. With this news, Mr. Wright was once again excited to receive the new medicine.

This time with great fanfare, Dr. West administered an injection of saline water. Mr. Wright regained his optimism and his second recovery was even more rapid than his first. He was asymptomatic and apparently cancer free for two months. Unfortunately, the final results of the Krebiozen study came in and the AMA announced to the press, *"nationwide tests show Krebiozen to be a worthless drug in the treatment of cancer."* When he heard this pronouncement, Mr. Wright's condition once again deteriorated and he was dead two days later.[1,2]

While this remarkable true story is often quoted as an example of the placebo effect, it also provides a vivid illustration of the power of the mind to control the body. Since 1957, when this case was first presented, much more research into the underlying mechanisms of 'mind-body' healing has been conducted.

Psychoneuroimmunology is the interdisciplinary field that explores the connections between the mind and emotions, the brain and central nervous system, and the immune system. Since the terms used in neuroscience may not correspond with the terminology used in immunology, and these two fields barely speak the same language used in psychology, the specialists in this field must be able to see the 'big picture'. These scientific 'mavericks' usually have an open mind to alternative ideas and concepts. D.D. Palmer, an alternative thinker of his time,

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founded chiropractic in 1895. It is probable that if he were alive today, the science of psychoneuroimmunology would draw D.D. Palmer's interest. In 1910 he wrote:

"While it is a fact, that thots are things, are entities, that we influence each other and ourselves for good or bad by our thinking, it is also a fact that it is a mental condition, in and of ourselves. It is one of the three methods I recognize of creating normal and abnormal nerve and muscle tension."[3]
"Love or hate, joy or grief, fear or boldness, affect the secretions of glands and follicles."[4]

The scientific foundation for psychoneuroimmunology was first laid by Walter Cannon, who wrote the classic text, *The Wisdom of the Body.*[5] Cannon coined the term *homeostasis* referring to the self regulating ability of the body to maintain a steady and stable equilibrium, despite external challenges. D.D. Palmer would surely find this in keeping with his concept of innate intelligence and 'tone'. Cannon's study of adrenal gland function helped him to define the 'fight or flight' response. When we are placed under physical or psychological danger, the adrenal gland secretes epinephrine, which causes a panorama of changes in the body. Heart rate and blood pressure rise to prepare the body for physical activity. The pupils dilate and the brain becomes very alert to all sensory input. Because digestion and immune function are not critical to the immediate danger, these functions are suppressed.

Stress Response

While the 'fight or flight' response is essential for short term survival, sustained stress can damage the body. Another medical pioneer who continued this line of research was Hans Selye. If you have not read his book, *The Stress of Life*, you have missed an entertaining look into a great mind at work. Dr. Selye was clearly one of the 'mavericks' who attempted to see the big picture. Listen to the narrative of his days as a medical student at the University of Prague in 1925:

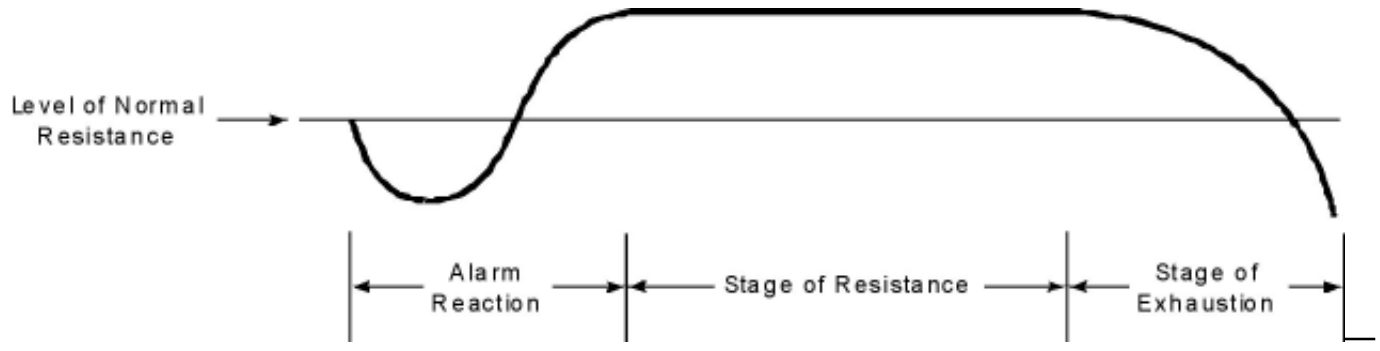
"It so happened that, on that day, by way of an introduction, we were shown several cases in the earliest stages of infectious diseases. As each patient was brought into the lecture room, the professor carefully questioned and examined him. It turned out that each of these patients felt and looked ill, had a coated tongue, complained of more or less diffuse aches and pains in the joints, and of intestinal disturbances with loss of appetite. Most of them also had fever (sometimes with mental confusion), an enlarged spleen or liver, inflamed tonsils, a skin rash, and so forth. All this was quite evident and the professor seemed to attach very little significance to any of it."
"Then, he enumerated a few "characteristic" signs which might help in the diagnosis of the disease. At present, our teacher said, most of the characteristic signs happened to be absent, but until they appeared, not much could be done."
"Even now–after half a century–I still remember vividly the profound impression these considerations made upon me at the time. I could not understand why, ever since the dawn of medical history, physicians should have attempted to concentrate all their efforts upon the recognition of individual diseases and the discovery of specific remedies for them, without giving any attention to the much more obvious "syndrome of just being sick." I knew that a syndrome is usually defined as "a group of signs and symptoms that occur together and characterize a disease." Well, the patients we had just seen had a syndrome, but this seemed to be the syndrome that characterized disease as such, not any one disease."
"Surely, if it is important to find remedies which help against one disease or another, it would be even more important to learn something about the mechanism of being sick and the means of treating this "general syndrome of sickness," which is apparently superimposed upon all individual diseases!"[6]

Dr. Selye spent his life researching the details of this 'general syndrome of sickness'. Building upon Cannon's study of the 'fight or flight' response, Selye discovered that with prolonged and repeated exposure to stressful events, laboratory rats developed a specific pattern of illness:

- enlargement of the adrenal cortex
- atrophy of the thymus, spleen, and lymphatic system
- gastrointestinal ulcers

He subjected the rats to various physical stressors, such as extremes of hot and cold, surgical trauma, strenuous exercise, as well as inflicting 'psychological' stress on the rats. He discovered that regardless of what he used to cause the prolonged stress, the physiological response pattern was remarkably consistent. Dr. Selye called this pattern the **General Adaptation Syndrome**. As he followed these animals over time he discovered three stages to this syndrome:

Figure 1. Selye's General Adaptation Syndrome



- **The alarm reaction** – The initial alarm reaction is essentially the 'fight or flight' response described by Walter Cannon.
- **The stage of resistance** – When stress is prolonged and the individual does not use physical activity to 'work off' the stress response, the body enters a prolonged resistance phase. High cortisol levels will normally trigger a homeostasis feedback loop that reduces hypothalamus and pituitary stimulation of the adrenal glands. However, prolonged stress short circuits this feedback loop and the body maintains a high level of physiological arousal. This is the phase that manifests the triad of adrenocortical stimulation, thymicolymphatic atrophy, and intestinal ulcers.
- **The stage of exhaustion** – While the time frame differs for each individual, eventually everybody will run out of energy reserves. This phase is also known as adrenal exhaustion, and in years past was referred to as a 'nervous breakdown'. Sustained cortisol levels will suppress immune function and render the individual vulnerable to disease or even death.

Hans Selye died in 1982. For 50 years he wrote 40 books and published more than 1,700 scientific articles researching how the body copes with sustained stress. Most of Dr. Selye's research was on animals and involved physical stressors. However, in humans, most of the stressors we must deal with are psychological. In 1967 Holmes and Rahe described the relationship between major life events and becoming sick.[7] The researchers assigned a point value to various life events:

100	Death of spouse	39	Addition to family
73	Divorce	38	Change in financial status
65	Marital separation	37	Death of close friend
63	Jail term	36	Change to different line of work
63	Death of close family member	30	Foreclosure of mortgage or loan
53	Personal injury or illness	29	Son or daughter leaving home
50	Marriage	29	Trouble with in-laws
47	Fired from work	26	Starting or finishing school
45	Marital reconciliation	23	Trouble with boss
45	Retirement	20	Change in residence
44	Change in family member's health	20	Change in schools
40	Pregnancy	12	Christmas season
39	Sex difficulties	11	Minor violation of the law

Based upon their research, if an individual scored 150 points within the past year the likelihood of becoming ill was approximately 50%. If the score was 300 points, that possibility rose to almost 90%. The duration of the stressful event must also be considered. While daily 'hassles' such as paying bills, difficult neighbors, or getting stuck in traffic may not qualify as a major event, they still take their toll. One of the most damaging components of the stressor is when the individual feels they have no control over the outcome.

What symptoms or conditions are likely to be experienced by an individual under chronic stress? Perhaps an even more appropriate question is to ask what conditions do not have chronic stress as a major contributing factor. It is well documented that stress can cause or worsen:

Hypertension	Crohn's disease
Cardiac arrhythmia	Skin disorders
Coronary heart disease	Insomnia
Bronchial asthma	Migraine headache
Peptic ulcer disease	Rheumatoid arthritis
Irritable bowel syndrome	Chronic pain syndromes

The fight or flight response triggers many changes in the body, such as a dramatic increase in blood flow to the muscles. However, when we do not engage in physical exertion to burn off this excess energy, this short term survival mechanism can create chronic health problems, such as hypertension. In today's high stress environment, 25% of adults suffer from high blood pressure.

Relaxation Response

Dr. Herbert Benson, another pioneer in psychoneuroimmunology, was a Harvard cardiologist searching for non-pharmaceutical treatments for hypertension. Dr. Benson's initial research involved using biofeedback to train monkeys to control their blood pressure. Upon learning of this research, a group of trancendental meditation practitioners approached Dr. Benson to continue his research using humans instead of monkeys. Initially he was reluctant to jeopardize his career by studying a modality that some might consider pseudo-scientific. However, Dr. Benson rose to the challenge and has devoted his career to researching what came to be known as 'the relaxation response'.

When he used instrumentation to study the meditators, Dr. Benson found a number of interesting results. Within a few minutes oxygen consumption dropped 17%. The heart and respiratory rate slowed and brain wave patterns shifted to a lower frequency pattern, indicative of rest and relaxation. Blood chemistry measurements showed decreased blood lactate, a chemical observed during anxiety. Paradoxically, he did not find the drop in blood pressure he had expected. He later learned that this was because these meditators had already lowered their blood pressure, and no further lowering was possible. Individuals with high blood pressure usually do benefit from practicing the relaxation response.

The trancendental meditation technique, more commonly known as TM, was originated by the Maharishi Mahesh Yogi from India. When initiated into this training, practitioners are given a *mantra* to use as a mental focus point. Dr. Benson found that the word 'One' worked equally well as a focus point. Here are the steps to elicit the relaxation response:[8]

1. Pick a focus word or phrase, such as: One, Love, Peace, Relax, Shalom, Om, or The Lord is my shepard.
2. Sit quietly in a comfortable position.
3. Close your eyes.
4. Relax your muscles.
5. Breathe slowly and naturally, and on each exhalation, mentally repeat your focus word or phrase to yourself.
6. Assume a passive attitude. Don't worry about how well you are doing. When other thoughts come to mind, simply say to yourself, *"Oh, well,"* and gently return to your focus word.
7. Continue for 10 to 20 minutes.

8. Do not stand immediately. Continue sitting quietly for a minute or so, allowing other thoughts to return. Then open your eyes and sit for another minute before rising.
9. Practice this technique once or twice daily.

Over the years there has been a tremendous amount of research documenting the health benefits of the relaxation response. Physiologically, the relaxation response almost seems to be an antidote to the stress changes observed during the fight or flight response: [9]

Physiological State	Fight or Flight Response	Relaxation Response
Metabolism	Increases	Decreases
Blood Pressure	Increases	Decreases
Heart Rate	Increases	Decreases
Respiratory Rate	Increases	Decreases
Blood Flow to Extremities	Increases	Stable
Muscle Tension	Increases	Decreases
Alpha Brain Waves	Decrease	Increase

Dr. Benson later came to believe that the effectiveness of the relaxation response is made more potent by incorporating prayer and the religious tradition of the individual into the technique.[10]

The Placebo Effect

Because of the power of belief, the placebo effect undoubtedly contributes to the effectiveness of the relaxation response. It is well documented that some patients will experience an improvement solely because of their expectation the treatment will help them. The word placebo comes from the Latin *placere*, meaning *'I shall please'*. The placebo effect is the main reason researchers use randomized controlled trials (RCT). In a double blind trial neither the patients nor the doctors administering the treatment know who is receiving the real or the placebo treatment until the conclusion of the study. In a classic 1955 study, Henry Beecher found that 35% of more than 1,000 patients showed improvement from the placebo.[11] More recent trials have found that the placebo effect may be twice as powerful as predicted by the Beecher study.[12,13] A recent review of the effectiveness of anti-depressant medications, such as Prozac, Zoloft, and Paxil, found, *"75% of the response to the medications examined in these studies was a placebo response, and at most, 25% might be a true drug effect."*[14]

At times it almost seems as if the prevailing attitude in medicine views the placebo effect as an obstacle to the process of finding new and effective treatments. Suppose a double blind trial disclosed the experimental group had a 20% better outcome than the control group. This is considered 'highly significant', and you can be sure the drug company's publicity machine will kick into high gear to promote this new wonder drug. Let's change our perspective and look at this from the point of view of a patient trying to get well. The placebo effect is acknowledged to help between 35-70% of patients, while drug therapy rarely achieves this level of significance. What is wrong with this picture? Instead of viewing the placebo effect as an obstacle to be overcome, we should be researching ways to maximize the power of the placebo effect. This a fertile area of research for psychoneuroimmunology: helping the mind to initiate and promote the healing process.

Detailing just a few studies might serve to illustrate the immense power of the mind to alter the body's physiology:

- Leaves from the Japanese lacquer tree cause a contact dermatitis similar to poison ivy. In 1962, 57 high school boys were blindfolded and one arm was brushed with leaves from the lacquer tree, while the other arm was brushed with chestnut tree leaves, that do not normally cause contact dermatitis. However, once the boys were blindfolded, the researchers switched the leaves. Specifically, when the boys were told they were being brushed with chestnut tree leaves they were actually brushed with leaves from the poisonous lacquer tree, and vice versa. Within a few minutes the arm that was brushed with what the boys thought were the poison leaves began to experience burning and itching with raised red bumps. In most cases, the arm that was touched with the poisonous leaves did not react. For these boys, the body created the physiological reaction appropriate for what the mind believed.[15]

- In a 1950 study, pregnant women who were experiencing nausea and vomiting typical of 'morning sickness' were given a drug they were told would cure their nausea. What they were actually given was ipecac, a drug given to cause vomiting. Their nausea and vomitting ceased entirely by taking a drug they believed would work. This was not just a subjective improvement. The researchers used a balloon catheter in the stomach to monitor stomach contractions before and after the drug.[16]

- A 1987 study looked at two hundred patients with non-specific complaints not attributable to any particular physical ailment. This is a very common occurence in clinical practice, and accounted for about one-half of the patients seen at this clinic. The patients received what was referred to as either a 'positive' or 'negative' consultation. In a positive consultation the doctor gave the patient a firm diagnosis and confidently remarked they could expect improvement within a few days. In a negative consultation the patient may have been told, *"I am not sure that the treatment I am going to give you will have an effect."* While both the positive and negative consultation groups thought they were receiving medication, both groups were given vitamins. 64% of 'positive' consultation patients got better within two weeks, versus only 39% of the 'negative' consultation group. In this study, when the diagnosis and treatment information were presented in a positive and confident manner the patients experienced a 25% better outcome.[17]

Dr. Benson is a medical pioneer who has generated a wealth of research documenting the innate healing ability of the body. His books are filled with clinical pearls such as:

"Other studies indicate that between 60 and 90 percent of all our population's visits to doctors' offices are stress-related and probably cannot be detected, much less treated effectively, with the medications and procedures on which the medical profession relies almost exclusively. In other

words, the vast majority of the time, patients bring medical concerns to the attention of a healing profession that cannot heal them with external tools or devices. Instead, doctors must rely on patients' internal mechanisms. Much of the success the medical profession achieves is not due to anything doctors do or dispense that is inherently healing. We should really attribute the success of many medical treatments to the inherent healing power within individuals."[18]

This *'inherent healing power'* is phenomenal. Anyone who has observed pictures of white blood cells attacking and destroying bacteria cannot help but be in awe of the power and intelligent function of the immune response. Because these immune cells can function *in vitro,* outside the body, researchers initially believed that the immune system was autonomous, and did not require nervous system input to function. Psychoneuroimmunology research has shown this to be false.

The word psychoneuroimmunology was coined by Dr. Robert Ader in 1981. In 1974, Ader was studying taste aversion in rats using classical conditioning, a technique discovered by Ivan Pavlov in the late 1800's. Pavlov rang a bell each time he fed the dogs he was studying. Later, as he sounded the bell, the dogs continued to salivate in anticipation of food, even when no food was given. The animals had been conditioned to salivate with only the sound of a bell.

In his experiment, Ader paired a saccharin flavored drink with cyclophosphamide, a drug that causes nausea. As expected, the rats quickly learned to associate the sweet drink with nausea. The purpose of his research was to determine if the rats that were given a larger dose of saccharin developed a stronger taste aversion response. However, an unexpected development was interfering with his study—the rats were dying.

Dr. Ader knew that cyclophosphamide, the drug he was using to induce nausea, was also an immune suppressant. However, even though it is a toxic drug, it was given only at the beginning of the study, and not in quantity large enough to account for the dying rats. With further research Ader discovered that just as Pavlov's dogs had been classically conditioned to salivate with the sound of a bell, his rats had been classically conditioned to suppress immune function when they tasted a sweet drink, long after the cyclophosphamide drug was withdrawn.[19]

To say that this was a groundbreaking discovery is not hyperbole. Ader's research has since been applied to the treatment of human illness. Marette was a little girl suffering from a severe case of systemic lupus erythematosus (SLE). Her medical treatment required the same cyclophosphamide drug used in Ader's research. After consulting with Dr. Ader, her doctors devised an experiment to administer a taste (cod liver oil) and smell (scent of rose perfume) at the same time as her chemotherapy session. After a few rounds of this drug–taste–smell combination, the drug was withdrawn and only the taste and smell treatment were given. The child's immune system continued to be suppressed by the taste and smell treatment, even after the chemotherapy was no longer a part of the regimen.[20]

By what mechanism does the brain and mind 'talk' to the immune system? Hans Selye's research documented that when animals are exposed to chronic stress, suppression of immune function will result. This appears to occur via an endocrine response, the hypothalamic pituitary adrenal (HPA) axis. However, is this mechanism sufficient to explain the classical conditioning of the immune system, or is there more to the story?

A few years after Ader's experiment, David Felten was an MD, PhD researcher investigating sympathetic nervous system pathways. Using electron microscopy and cell stains that highlight neurotransmitter receptors, he made a remarkable discovery: the cells of the thymus, spleen, and lymph nodes are covered with nerves.[21] The nerve to gland connections he observed were quite similar to traditional nerve to nerve synapse connections. Felten then sought to investigate the extent to which nerve to gland connections control immune function. His research found that blocking endocrine input only slightly affected immune function, whereas cutting sympathetic innervation brought the immune response to a complete halt. In effect the nervous system appears to be 'hard wired' to the immune system. We have come to assume that decreased immunity is a 'normal' consequence of growing old. One important result of Felten's research is the discovery that the weakened immune response that occurs with aging is in large part caused by nerve atrophy.[22]

Neuropeptides

It is estimated that the human nervous system has one hundred billion nerve cells. Each of these cells has between 1,000 and 500,000 synapse connections.[23] It boggles the mind to contemplate the fantastic number of connections within the human nervous system. The nervous system is usually conceptualized as electrical in nature with current travelling down the axon and 'jumping' across the synapse to the next nerve. However, the connections between nerve cells are actually chemical rather than electrical. The presynaptic neuron releases a small peptide molecule into the synaptic gap between the two cells. This neuropeptide travels across the synapse to a receptor on the postsynaptic neuron, which initiates a change in the postsynaptic neuron.

Acetylcholine was the first neuropeptide discovered in 1926. By 1975 approximately thirty neurotransmitter peptides had been identified. That number is now over sixty and one researcher has speculated that over 300 will eventually be found.[24] Neuropeptides are now referred to as *informational substances*, because of their role as messenger molecules distributing information throughout the body.[25] A number of new discoveries have forced us to rethink our understanding of how the nervous system functions:

- Neuropeptides and their receptors, once thought to function only in the brain, are now known to exist throughout the body. Peptides circulate through the body, finding their target receptors in regions far more distant than had ever previously been thought possible. The dorsal horn of the spinal cord contains high concentrations of almost every known neuropeptide receptor.
- Information transfer within the nervous system is traditionally thought to occur at the synapse. It is now known that less than 2 percent of neuronal communication actually occurs at the synapse. Information flow within the nervous

system is controlled primarily by the specificity of the neuropeptide receptors, rather than by the physical proximity of the nerve cells.[26]

- Peripheral hormones such as insulin and vasoactive intestinal peptide (VIP), also have receptors sites and are manufactured within the brain.[27]
- There are receptors on immune cells for every peptide identified in the brain. Not only is the immune system capable of receiving information from the brain via neuropeptides, the circulating cells of the immune system also manufacture neuropeptides and send this information to the brain. Because of their functional similarity with nerve cells, immune cells serve as a 'mobile synapse' conveying information within the body. The immune system can be viewed as another sensory input structure for the central nervous system. Some researchers have even used the phrase 'circulating nervous system' when refering to the white blood cells.
- Memory is encoded and stored at the receptor level. Since all cells have these receptors, it follows that all muscles and tissues of the body possess some degree of cellular memory.[28]

Candice Pert, while still a graduate student at Johns Hopkins University in 1972, perfected the techniques needed to identify the opiate receptor in the brain. This led to the discovery of endorphin and enkephalin, which in turn unleashed the flurry of research that identified a slew of new neuropeptides.

Dr. Pert continued her research at the National Institute of Mental Health where she served as chief of the Brain Biochemistry section. Her book, *Molecules of Emotion*, describes this journey of discovery and interprets its significance. What is the evidence to support calling neuropeptides 'molecules of emotion'? In 1926, while searching for a treatment of epilepsy, Wilder Penfield applied electrical stimulation to areas of the brain of conscious patients. During this research, he identified certain areas of the brain that appear to be the focal point for emotions. As Dr. Pert and her team identified previously unknown neuropeptides, they also localized the nodal points or 'hot spots' where the receptors for these neuropeptides were concentrated:

> *"Core limbic brain structures, such as the amygdala, hippocampus, and limbic cortex, believed by neuroscientists to be involved in emotional behavior contained a whopping 85 to 95 percent of the various neuropeptide receptors we had studied!"*[29]

So anatomically these neuropeptide 'molecules of emotion' are concentrated in areas of the brain that are known to regulate emotional behavior. We traditionally think of emotion in terms of love, hate, fear, anger, etc. However, when we incorporate our new understanding of neuropeptides, we may have to expand our definition of 'emotion'. We now know that the entire intestinal tract is lined with cells that contain neuropeptides and their receptors. Perhaps the phrase 'gut feeling' is more than a symbolic figure of speech. While serotonin is traditionally thought of as a brain neuropeptide, 95% of the body's serotonin is found in the enterochromaffin cells and enteric neurons of the gut.[30]

The diverse distribution of neuropeptides is even more profound than previously imagined. The techniques used to identify neuropeptide receptors in the brain have been used to study other animals. In fact, many of the human neuropeptides were first discovered in other animals. Bradykinin was discovered in snake venom, bombesin was first extracted from the skin of the *bombix bombina* frog, and the receptor for acetylcholine was first isolated in the electric eel. Single celled organisms such as *clostridium*, *E. coli*, and *tetrahymena* manufacture and have receptor sites for TSH, hCG, neurotensin, insulin, somatostatin, ACTH, endorphin, relaxin, and calcitonin. Even plants such as alfalfa, wheat, tobacco, and spinach contain messenger peptides such as LHRH, TRH, endorphin, interferon, insulin, and somatostatin.[31]

Why would plants and microorganisms use the same peptides that function as messenger molecules in man? Neuropeptides appear to be a fundamental 'building block' of creation. Just as all life forms use the same four DNA base pairs to code genetic information, it is theorized that neuropeptides are common messenger molecules that serve to transmit information throughout the organism. These molecules evolved first in the most simple plants and animals. As creation manifested higher multicellular organisms, these peptide messenger molecules were incorporated into the nervous, endocrine, and immune physiology of the organism.

This discussion of neuropeptides is incomplete without mention of the subject of excitotoxins.[32] Within the last 50 years the food industry has invented a number of substances used to alter the taste of food. Of special concern are monosodium glutamate (MSG) and aspartame (NutraSweet). Glutamate and aspartic acid are the two most plentiful amino acids within the human brain, and glutamate is the brain's primary excitatory neurotransmitter. However, even though they are always present within the brain, these amino acids are normally found in relatively small concentrations. When we eat foods laced with MSG or diet drinks sweetened with NutraSweet, the body is flooded with these excitatory neurotransmitter substances, to a level 5-20 times greater than normally present within the blood. This neurotransmitter excess can cause repetitive firing of neurons, and when this continues without rest, neurons can eventually fatigue and die. This is the origin of the term excitotoxin – the neurons are literally worked to death. Most health problems are multi-factorial. However, there is growing evidence that these artificial food additives accelerate neurodegeneration in individuals with a genetic predisposition to conditions such as Parkinson's disease, Alzheimer's dementia, and amyotrophic lateral sclerosis (ALS). Because these substances readily pass the placental barrier from mother to fetus, there is also speculation that MSG and NutraSweet have contributed toward the dramatic increase in Attention Deficit Hyperactivity Disorder (ADHD).

Conclusion

We are just beginning to uncover the mysteries of the body's inherent healing power. Just as all cells in the body are touched upon by nerves, every cell in our body is covered with thou-

sands of neuropeptide receptors. These neuropeptides are produced and move throughout the body for the purpose of transmitting information. Several chiropractic techniques place emphasis upon the normalization of cerebrospinal fluid flow. Perhaps we should borrow the line from the movie Ghost Busters, *"Who are you going to call?"* (to get your CSF flow normalized). If we keep in mind that only 2% of neurotransmitters act at the local synapse, chiropractors could play a pivotal role in researching this area of psychoneuroimmunology.

In the past, chiropractors have been labeled unscientific because we maintain that our treatment releases the flow of innate intelligence within the body. If we substitute the terms 'neurotransmitter messenger molecules' for 'innate intelligence', perhaps we are closer to a scientific explanation of how chiropractic 'works'. As our knowledge grows, we will develop a greater understanding and respect for the words of the founder of chiropractic:

> *"The Chiropractor looks upon the body as more than a machine; a union of consciousness and unconsciousness; Innate's ability to transfer impulses to all parts of the body—the coordination of sensation and volition: a personified immaterial spirit and body linked together by the soul—a life directed by intelligence uniting the immaterial with the material."*[33]

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